

Method of Test for
WATER SUSCEPTIBILITY OF ASPHALTIC CONCRETE MATERIALS
DOTD Designation: TR 317M/TR 317-97

Method A - Product Qualification

I. Scope

- A. This method of test describes the procedure for qualifying anti-strip additives to be incorporated into the asphalt cement to be used in asphaltic mixtures. The additives are proportioned in an asphalt-additive mixture at a rate of 0.5 percent by weight of asphalt cement.
- B. Reference Document
DOTD TR 610, Infrared Spectrophotometric Analysis

II. Apparatus

- A. **Oven** - of constant temperature, capable of maintaining a temperature of $160 \pm 3^{\circ}\text{C}$ ($325 \pm 5^{\circ}\text{F}$).
- B. **Balance** - having a minimum capacity of 200 g and sensitive to 0.1 g.
- C. **Containers** - disposable, approximately 0.5 L (1 1/4 pint) (No. 2) metal containers and friction top liter (quart) and four-liter (gallon) metal containers.
- D. **Beakers** - 400 mL beakers.
- E. **Hot plates** - hot plates equipped with heat dispersing mats as needed.
- F. **Miscellaneous equipment** - stopwatch, spatulas, gloves, thermometers, aluminum foil, paper towels, etc.
- G. **Distilled water**.
- H. **Sheet aluminum** - approximately 0.5 m by 0.5 m (1.5 ft by 1.5 ft) or of sufficient size to accommodate the aggregate/asphalt mixture.
- I. **Worksheet** - Anti-Strip Additive (Fig. A-2).

III. Materials

- A. **Reference aggregates** - three standard aggregates of known past performance taken from approved aggregate sources. The aggregates shall be crushed and of such size that 100 percent passes a 9.5 mm (3/8 in.) sieve and is retained on a 4.75 mm (No. 4) sieve.
- B. **Reference asphalt cements** - two standard asphalt cements - AC-30, which are taken from approved refinery tanks.

- C. **Anti-strip additive** - approximately 0.5 L (1 pt).

IV. Health Precautions

Proper precautions are to be taken whenever hot materials or equipment must be handled. Use container holder or thermal gloves while handling hot containers. Wear eye protection while stirring and weighing heated materials due to possible shattering of particles. Dry contaminated materials under a vent to prevent exposure to fumes.

V. Sample Identification

An infrared spectrophotometric analysis of the anti-strip additive will be performed in accordance with DOTD TR 610 for the purpose of permanent identification.

VI. Procedure

- A. Prepare a mixture as follows, using the anti-strip additive with each reference asphalt and combined with each reference aggregate.
 - 1. Heat the asphalt cement until it is readily pourable, approximately 135°C (275°F), but not to exceed 175°C (350°F).
 - 2. Pour 50.0 g of asphalt cement into a clean tared liter (quart) can.
 - 3. Add 0.5 g of additive.
 - 4. Pour an additional 50.0 g of asphalt cement into the mixture.
 - 5. Transfer the mixture from the balance to the hot plate and, while stirring, return the material to 135°C (275°F).
 - 6. Place a friction top loosely on the liter (quart) can (being careful not to seal the can); put the liter (quart) can inside an empty four liter (gallon) can; and place a perforated friction top on the four-liter (gallon) can.
 - 7. Put the four-liter (gallon) can in an oven operating at $160 \pm 3^{\circ}\text{C}$ ($320 \pm 5^{\circ}\text{F}$) for 24 ± 2 hours.

8. Place 95.0 g of oven dried unwashed aggregate into a clean 0.5 L mixing can and put the can in the oven operating at $160 \pm 3^\circ\text{C}$ ($320 \pm 5^\circ\text{F}$) for 1 to 1½ hours.

9. Remove both containers from the oven. Add 5.0 g of the asphalt additive mixture to the aggregate container. Mix thoroughly so that all aggregate surfaces are coated.

B. Immediately empty the aggregate asphalt mixture onto a clean piece of aluminum sheeting and allow to cool at room temperature for 2 hours ± 5 minutes.

C. Fill a 400 mL beaker approximately half full with distilled water and heat to boiling on a hot plate. Transfer the cooled mixture into the beaker of boiling water and begin timing when water resumes boiling and continue to boil for 10 minutes.

D. Remove the beaker from the heat source and dip the tip of a paper towel into the beaker to skim off any asphalt from the surface of the water.

E. Drain the water from the beaker and empty the remaining mixture onto a paper towel. Allow to cool to room temperature.

F. Allow three laboratory personnel to visually determine the percent coating without manipulating the sample in any way.

G. Record each of the observations on the worksheet.

VII. Calculations

A. Calculate the average rating of each combination (T_{ax} , T_{ay} , T_{az} , T_{bx} , T_{by} , T_{bz}) to the nearest 1 % using the following formula:

$$T_{ax} = \frac{T_{ax_1} + T_{ax_2} + T_{ax_3}}{3}$$

$$T_{ay} = \frac{T_{ay_1} + T_{ay_2} + T_{ay_3}}{3}$$

$$T_{az} = \frac{T_{az_1} + T_{az_2} + T_{az_3}}{3}$$

$$T_{bx} = \frac{T_{bx_1} + T_{bx_2} + T_{bx_3}}{3}$$

$$T_{by} = \frac{T_{by_1} + T_{by_2} + T_{by_3}}{3}$$

$$T_{bz} = \frac{T_{bz_1} + T_{bz_2} + T_{bz_3}}{3}$$

where:

x, y, z = aggregate source

a, b = asphalt cement source

1, 2, 3 = individual rater

B. Calculate the percent of visible surface area coated with asphalt to the nearest 1 % using the following formula:

$$\text{Retained Asphalt Coating, \%} = \frac{T_{ax} + T_{ay} + T_{az} + T_{bx} + T_{by} + T_{bz}}{6}$$

example:

Average the results of the observations shown in Figure A-1 to determine the percent of visible surface area coated with asphalt.

$$\text{Retained Asphalt Coating, \%} =$$

$$\frac{92 + 98 + 88 + 92 + 77 + 92}{6}$$

$$= \frac{539}{6}$$

$$= 89.83$$

$$\text{Retained Asphalt Coating, \%} = 89\%$$

VIII. Report

Report the retained asphalt coating to the nearest percent.

IX. Normal Test Reporting Time

The normal test reporting time is 2 days.

Six Different Combinations of Anti-strip Additive/ Aggregate/ Asphalt Cement	VISIBLE SURFACE AREA COATED, %			
	Ratings of Individual No. 1	Ratings of Individual No. 2	Ratings of Individual No. 3	Average Rating
(ASA) (X) (A)	$Tax_1 = 90\%$	$Tax_2 = 95\%$	$Tax_3 = 90\%$	$Tax = 92\%$
(ASA) (Y) (A)	$Tay_1 = 75\%$	$Tay_2 = 80\%$	$Tay_3 = 80\%$	$Tay = 98\%$
(ASA) (Z) (A)	$Taz_1 = 100\%$	$Taz_2 = 95\%$	$Taz_3 = 100\%$	$Taz = 88\%$
(ASA) (X) (B)	$Tbx_1 = 90\%$	$Tbx_2 = 90\%$	$Tbx_3 = 85\%$	$Tbx = 92\%$
(ASA) (Y) (B)	$Tby_1 = 70\%$	$Tby_2 = 80\%$	$Tby_3 = 80\%$	$Tby = 77\%$
(ASA) (Z) (B)	$Tbz_1 = 95\%$	$Tbz_2 = 90\%$	$Tbz_3 = 90\%$	$Tbz = 92\%$

ASA = anti-strip additive
 X, Y, Z = aggregate source
 A, B = asphalt cement source

Figure A-1

7/97

REMARKS 2

[illegible]

P/F

ADHERE LA 2 XXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXX	1
------------------------------	---

SOLIDS CONTENT, % ($\frac{B}{A}$).....

Wt. of Sample After Heating (B)

[illegible]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

89 1 p

ASA = anti-strip additive
X, Y, Z = aggregate source
A, B = asphalt cement source

APPROVED by: B. C. S. Date: 08/08/97

09/ 222-22-2222 /547/ 2 2 - 999/69 /N

Figure A-2
Anti-Strip Additive Worksheet

DOTD Designation: TR 317M/317-97

METHOD B - JMF EVALUATION

I. Scope

This method of test describes the procedure for evaluating the water susceptibility of a job mix formula combination of asphalt cement, anti-strip additive and coarse aggregate. The additive is proportioned in an asphalt-additive mixture at the rate specified in the job mix formula.

II. Apparatus

- A. **Oven** - constant temperature, capable of maintaining a temperature of $160 \pm 3^{\circ}\text{C}$ ($320 \pm 5^{\circ}\text{F}$).
- B. **Balance** - a balance having a minimum capacity of 200 g and sensitive to 0.1 g.
- C. **Containers** - disposable, approximately 0.5 L (1 1/4 pint) (No. 2) metal containers and friction top liter (quart) and four liter (gallon) metal containers.
- D. **Beakers** - 400 mL beakers.
- E. **Hot plates** - hot plates equipped with heat dispersing mats as needed.
- F. **Miscellaneous equipment** - stopwatch, spatulas, gloves, thermometers, aluminum foil, paper towels, etc.
- G. **Distilled water**.
- H. **Sheet Aluminum** - approximately 0.5 m by 0.5 m (1.5 ft by 1.5 ft) or of sufficient size to accommodate the aggregate/ asphalt mixture.
- I. **Worksheet** - Retained Asphalt Coating, DOTD Form No. 03-22-0733 (Figure B-2).

III. Materials

- A. **Aggregate** - aggregate from the source specified on the job mix formula (JMF) submitted for test. The aggregate shall be crushed and of such size that 100 percent passes a 9.5 mm (3/8 inch) sieve and is retained on a 4.75 mm (No. 4) sieve.
- B. **Asphalt cement** - the specified JMF asphalt cement shall be used for the test.
- C. **Anti-strip additive** - as specified on the job mix formula shall be used at the specified JMF percentage for the test.

IV. Health Precautions

Proper precautions are to be taken whenever hot materials or equipment must be handled. Use container holder or thermal gloves while handling hot containers. Wear eye protection while stirring and weighing heated materials due to possible shattering of particles. Dry contaminated materials under a vent to prevent exposure to fumes.

V. Procedure

- A. Prepare three individual mixtures as follows, using the material designated by the submitted job mix formula.
 - 1. Heat the asphalt cement until it is readily pourable, approximately 135°C (275°F) but not to exceed 160°C (320°F).
 - 2. Pour 50.0 g of asphalt cement into a clean tared liter (quart) can.
 - 3. Add the specified JMF percentage of additive to the measured asphalt cement.
 - 4. Pour in an additional 50.0 grams of asphalt cement.
 - 5. Transfer the can containing the asphalt and anti-strip mixture from the balance to the hot plate and return the material to 135°C (275°F) while stirring.
 - 6. Place a friction top loosely on the liter (quart) can (being careful not to seal the can); put the liter (quart) can containing the asphalt cement inside and empty four-liter (gallon) can; and place a perforated friction top on the four-liter (gallon) can.
 - 7. Put the four-liter (gallon) can in an oven operating at $160 \pm 3^{\circ}\text{C}$ ($320 \pm 5^{\circ}\text{F}$) for 24 ± 2 hours.
 - 8. Place 95.0 g of oven dried unwashed aggregate into a clean 0.5 L mixing can and put the can with the aggregate in the oven operating at $160 \pm 3^{\circ}\text{C}$ ($320 \pm 5^{\circ}\text{F}$) for 1 to 1 1/2 hours.
 - 9. Remove both containers from the oven. Add 5.0 g of the asphalt-additive mixture into the aggregate container. Mix thoroughly with a spatula so that all aggregate surfaces are coated.

- B. Immediately empty the aggregate-asphalt mixture onto a clean piece of aluminum sheeting and allow to cool at room temperature for 2 hours \pm 5 minutes.
- C. Fill a 400 mL beaker approximately half full with distilled water and heat to boiling on a hot plate. Transfer the cooled asphalt-aggregate mixture into the beaker of boiling water and begin timing when water resumes boiling and continue to boil for 10 minutes.
- D. Remove the beaker from the heat source and dip tip of a paper towel into the beaker to skim off any asphalt from the surface of the water.
- E. Drain the water from the beaker and empty the remaining mixture onto a paper towel. Allow to cool to room temperature.
- F. Allow three laboratory personnel to visually determine the percent coating without manipulating the sample in any way.
- G. Record each of the observations on the worksheet.

VI. Calculations

- A. Calculate the rating of each mixture (T_a , T_b , T_c) to the nearest 1 % using the following formulas:

$$T_a = \frac{T_{a_1} + T_{a_2} + T_{a_3}}{3}$$

$$T_b = \frac{T_{b_1} + T_{b_2} + T_{b_3}}{3}$$

$$T_c = \frac{T_{c_1} + T_{c_2} + T_{c_3}}{3}$$

where:

a, b, c = each of three mixtures
1, 2, 3 = each of three raters

- B. Calculate the percent of visible surface area coated with asphalt (retained asphalt coating) to the nearest 1 % using the following formula:

$$\text{Retained Asphalt Coating, \%} = \frac{T_a + T_b + T_c}{3}$$

example:

Average the results of the observations shown in Figure B-1 to determine the percent of visible surface area coated with asphalt.

$$\text{Retained Asphalt Coating, \%} = \frac{92 + 98 + 90}{3}$$

$$= \frac{280}{3}$$

$$= 93.33$$

$$\text{Retained Asphalt Coating, \%} = 93$$

VII. Report

Report the retained asphalt coating to the nearest percent.

VIII. Normal Test Reporting Time

The normal test reporting time is 2 days.

Three Individual Mixtures of the Same Combination of JMF Materials	VISIBLE SURFACE AREA COATED, %			
	Ratings of Individual No. 1	Ratings of Individual No. 2	Ratings of Individual No. 3	Average Rating
Mixture A	Ta ₁ = 90%	Ta ₂ = 95%	Ta ₃ = 90%	Ta = 92%
Mixture B	Tb ₁ = 95%	Tb ₂ = 100%	Tb ₃ = 100%	Tb = 98%
Mixture C	Tc ₁ = 85%	Tc ₂ = 95%	Tc ₃ = 90%	Tc = 90%

Figure B-1

MATT MENU SELECTION - 09

DOTD 03-22-0733 (5/97)
METRICLouisiana Department of Transportation and Development
Materials and Testing Section
RETAINED ASPHALT COATING
(DOTD TR 317 - METHOD B)

Project No. 222-22-2222 Date Rec'd. 8-1-97
 Material Code 549 Lab No. 58-999169
 Date Sampled 08-04-97 Submitted By 0593
 Quantity Units kg Purpose Code 3
 Plant Code H914 Spec. Code 1
 P O No. Date Tested 08-08-97
 Ident. BT-104

Remarks 1 BOIL TEST FOR JMF SEQ. 134
 Remarks 2
 Item No. 501101111
 Sampled By: SDS Date: 08-04-97

PURPOSE CODES
 1. Quality Control
 2. Verification
 3. Acceptance
 4. Check
 5. Resample
 6. Source Approval
 7. Design
 8. Independent Assurance
 9. Preliminary Source Test

JOB MIX FORMULA SEQUENCE NO. 134 P/F XXX
 MIX CODE 51 XXX
 SOURCES: XXXXXXXXXXXXXXXXXXXX XXX
 AGGREGATE Vulcan Mat'l's. - Sandstone 41089 XXX
 ASPHALT CEMENT Ergon - PAC 30 41179 XXX
 ANTI - STRIPPING ADDITIVE ARR MAZ - Adhere LA 2 51730 XXX
 % ANTI - STRIPPING ADDITIVE USED IN MIX 0.5 XXX
 RETAINED ASPHALT COATING, % (DOTD TR 317) 93 P
 LOT NUMBER XXX

Three-Individual Mixtures of the Same Combination of JMF Materials	VISIBLE SURFACE AREA COATED, %			
	Rating of Indiv. No. 1	Rating of Indiv. No. 2	Rating of Indiv. No. 3	Average Rating
Mixture A	Ta ₁ <u>90</u> %	Ta ₂ <u>95</u> %	Ta ₃ <u>90</u> %	Ta <u>92</u> %
Mixture B	Tb ₁ <u>95</u> %	Tb ₂ <u>100</u> %	Tb ₃ <u>100</u> %	Tb <u>98</u> %
Mixture C	Tc ₁ <u>85</u> %	Tc ₂ <u>95</u> %	Tc ₃ <u>90</u> %	Tc <u>90</u> %

Tested by: ALIN Checked by: P.F.Q. Date: 08-08-97
 APPROVED BY: District Laboratory Engineer Date: 08-09-97

Figure B-2
 DOTD 03-22-0733 Retained Asphalt Coating